29. (Unchanged) The impeller claimed in claim 28 wherein said prespecified angle is 82.3° for said downstream face of said vane.

30. (Unchanged) The impeller claimed in claim 21 wherein said entrance angle lies within a range of 5° to 30° and said exit angle lies within a range of 15° to 50°.

31. (Unchanged) The impeller claimed in claim 21 wherein a tangent drawn at a center portion of said vane is normal to said direction of rotation.

REMARKS

The specification inclusive of drawings and claims has been revised as indicated above. Procedurally, all of the amendments have been made to comport with the requirements of 37 C.F.R. §1.121. More specifically, three drawing sheets containing proposed corrections for Figures 1-6 are offered as replacements for the like-numbered drawing sheets previously filed. In revising the drawings, care has been taken to avoid the introduction of any new matter. The claims have been amended to improve clarity and to assure that they overcome the prior art of record. Applicant believes that the application is now in condition for allowance.

Review of the Present Invention as Contrasted with Copending Application Serial No. 09/571,825:

From a study of the outstanding Office Action, and in particular from the double patenting rejections set forth therein, it is believed that there is not a clear understanding of the structural configuration of the present invention and how that structural configuration differs from the structural configuration of the invention disclosed and claimed in copending application Serial No. 09/571,825. Accordingly, it is believed that it will be beneficial to initially review the similarities and distinct differences between the two applications.

Both of the present application and copending Serial No. 09/571,825 relate to specific configurations for the impeller blades of regenerative turbine pumps. In both applications, the impeller blades are formed as part of a driven disc member and project radially outward from a hub member (e.g., 26) thereof. Similarly, in both applications, the impeller blades appear as generally "V-shaped vanes" when the driven disc is viewed edgewise. In each application, the general "V-shape of each vane is formed by two diverging fins 30a and 30b. See, for example, Figures 5 and 6 in both applications. In each application, the two diverging fins 30a and 30b have inner and outer sidewalls, with the inner sidewalls of the two diverging fins being joined together. Each fin terminates in an outer sidewall (e.g., 32a or 32b). These outer sidewalls

generally lie in the plane of the top and bottom surfaces of the hub member 26.

Reference is now made to Figure 12 of copending Serial No. 09/571,825, wherein it is seen that the trailing edge of preferably each of the outer sidewalls 132a and 132b is provided with a "chamfer" 133 to improve the pumping efficiency.

Reference is now made to Figures 7 and 10 of copending Serial No. 09/571,825, which are top and bottom views of the driven impeller disc of the invention there disclosed and claimed. There it will be seen that *each of the "V-shaped vanes" of that invention project in a straight line fashion directly radially outward from the axis of rotation 4*. In actuality, in the top and bottom views of the driven disc shown in Figures 7 and 10 of copending Serial No. 09/571,825, each V-shaped vane appears as two spaced radial lines, one radial line representing the forward edge of the V-shaped vane and the next radial line representing the trailing edge of the V-shaped vane, the two radial lines being spaced from one another by the circumferential extension of the V-shaped vane.

Attention is now directed to the drawings of the present application, and initially, to Figure 5 thereof, which shows a prior art V-shaped impeller van. For purposes of clarifying the present invention, two areas of the V-shaped vane have been designated as the "entrance portion" (not shaded in Figure 5) and the "exit portion" (shaded in Figure 5). They are so designated in Figure 5

in respect of the small flow pattern also shown there. As fully explained within the specification, in operation, each fin of each V-shaped vane creates a small toroid or "whirlpool" flow on its leading face. This flow leaves the pumping channel 23 and enters the leading face in the interior portion of the fin, i.e., the portion of the fin adjacent to the hub 26. Thus the term "entrance portion". The small whirlpool flow leaves the leading face of the fin and reenters the pumping channel in the most radially outward portion of the fin. Thus the term "exit portion".

Now reference is most specifically directed to Figure 7 of the present application, which is a top view of the impeller disc, and to Figure 9 which is an enlarged portion thereof. Most particularly, Figures 7 and 9 of the present application are to be compared to and contrasted with Figures 7 and 10 of copending Serial No. 09/571,825.

As pointed out above, in Figures 7 and 10 of copending Serial No. 09/571,825, the leading and trailing edges of each of the V-shaped vanes appear as circumferentially spaced *straight radial lines* In contrast, in Figures 7 and 9 of the present application, *the leading edge of each of the V-shaped vanes is of a non-linear configuration*. For example, reference numerals 61 and 62 of the present application denote, respectively, the "entrance" and "exit" portions of each V-shaped vane or fin. It will be seen that, while entrance portion 61 projects essentially radially outward from the

axis of rotation 4 in a generally straight line fashion, exit portion 62 is "canted" or "angularly offset" with respect to entrance portion 61. This can be seen even more clearly by locating reference numerals 63b and 64b in Figure 9 of the present application which denote the trailing edge chamfers preferably provided on each of the outer sidewalls of each of the entrance portion fin and exit portion fin, respectively.

In other words, in the present application, each V-shaped vane does not project outwards from the hub 26 in a straight line fashion, as in copending Serial No. 09/571,825, but rather in a non-linear fashion.

There are two preferred embodiments of this non-linear radially outward extension of the impeller blades set forth in the present application. The first has been discussed above in connection with Figures 7 and 9, wherein the exit portion of the V-shaped vane is "canted" forward, or aligned in a "dogleg" or "angular" fashion with respect to the entrance portion. The second preferred embodiment is most particularly shown in Figure 13, wherein the entrance portion 161 and the exit portion 162 are not formed as sharply broken angularly disposed segments, but rather form a smooth continuous arcuate curve. They are, however, in both cases, arranged in a *non-linear disposition with respect to one another* in their radial extension from the axis of rotation 4.

The purpose of forming the exit portion of each V-shaped vane such that it is inclined toward the angle of rotation with respect to the entrance portion is clearly set forth within the specification, such as, for example, at page 9, lines 5-16, it is stated, in part: "[T]he angular momentum of the fuel as it flows within the annular pump channel 23 would be increased if the fuel were to exit from the exit portion 38 in a direction that is more tangential with respect to the annular pump channel 23. In addition, because the vanes extend radially outward form hub 26, the fuel as it enters the root of each fane 30 loses energy at the point at which it impacts the entrance portion." Thus, by canting the exit portion with respect to the entrance portion, the fuel is given more of a tangentially forward momentum with respect to the pump channel.

Summing up:

Copending Serial No. 09/571,825 discloses and claims impeller blades having a chamfer to improve pump efficiency. It has distinguished over U.S. Patent No. 5,299,908 to Robbie, and all other references, by the distinction of the chamfer being disposed directly within the pump channel. Copending Serial No. 09/571,825 neither discloses nor claims the patentably distinguishing features of the present application, wherein the entrance and exit portion of each V-shaped impeller blade are arranged in a non-linear disposition with respect to one another.

It is respectfully submitted that, with these differences and distinctions kept firmly in mind, that the remaining issues raised in the outstanding Office Action can be disposed with readily and the present application brought to issue.

The Amendments to the Claims:

This application presently contains three independent base claims, Claims 1, 11 and 21, with all other claims depending therefrom.

Independent Claim 1 is directed to both of the preferred embodiments, namely, the sharply angularly broken embodiment of Figures 7-12 and the continuously curved embodiment of Figures 13-14.

Independent Claim 11 is directed solely to the sharply angularly broken embodiment of Figures 7-12.

Independent Claim 21 is directed solely to the continuously curved embodiment of Figures 13-14.

Each of independent base Claims 1, 11 and 21 has been amended herein in order to even more fully, clearly and sharply define the patentable distinctions over both the prior art, as well as copending Serial No. 09/571,825 discussed above.

The Rejections Under 35 U.S.C. §102(b):

Claims 11, 13-14, 16-17 and 20 were rejected under 35 U.S.C. §102(b) based upon U.S. Patent No. 5,299,908 to Robbie.

a

Robbie relates to a regenerative pump having a housing 1 (formed of housing sections 11 and 12), an impeller 5 disposed within the housing 1, and a flow channel within the housing 1 extending between a pump inlet 13 and a pump outlet 14. As seen most clearly in Figures 1 and 2, a guide channel 15 is formed by annular depressions made in the side wall of each of the housing section 11 and 12. This guide channel 15 is centered about a radius R3 from the center axis of the impeller shaft 2. Referring most particularly to Figure 1, the guide channel extends from radius R2 to a radius of R2+2*(R3-R2).

Independent base Claim 1 recites an entrance portion and an exit portion aligned in a non-linear disposition with respect to one another along a dimension of each of said vanes. In contrast, the vanes disclosed in *Robbie extend, over their entire length, in a straight line fashion* radially outward from the axis of rotation, as is most clearly seen from the top view of the impeller blade shown in Figure 2 of Robbie. Robbie is devoid of any suggestion to form the radial extension of the impeller blades in a non-linear fashion as is disclosed and claimed in the present application.

Independent base Claim 11 recites an entrance portion that extends linearly outward from the outer cylindrical surface of the hub and an exit portion that extends linearly from a radially outward terminus of the entrance portion to the inner cylindrical surface of the outer ring…with said exit portion being inclined

forward of said entrance portion. As noted, Robbie only discloses impeller blades that radially extend in a straight line fashion, and is without teaching or suggestion of providing an exit portion that is inclined forward of the entrance portion.

Independent Claim 21 recites an entrance portion that extends from the outer cylindrical surface of the hub and an exit portion that extends from a radially outward terminus of the entrance portion the inner cylindrical surface of the outer ring, with each of the vanes being curved with the entrance portion drawing away from the outer cylindrical surface of the hub at an entrance angle with respect to a direction of rotation of the impeller and the exit portion advancing toward the inner cylindrical surface of the outer ring at an exit angle with respect to the direction of rotation.

Robbie teaches and suggests only impeller vanes that extend radially in a straight line over their entire extent.

In view of the present claim amendments and the above remarks, reconsideration and withdrawal of the rejections under 35 U.S.C. §102(b) based on Robbie is respectfully requested.

The Rejections Under 35 U.S.C. §103:

Claims 1, 3-4, 6-7, 21, 23-24, 26-27 and 31 were rejected under 35 U.S.C. §103(a) based upon Robbie, in view of U.S. Patent No. 5,762,469 to Yu.

As discussed above, Robbie provides neither teaching nor suggestion of providing impeller blades that change direction

(whether through an abrupt angular change or through a smooth curvilinear change) as they extend radially outward from the hub.

Yu discloses only vanes 54 that project outward at a right angle (i.e., 90°) from a separation partition 62. Thus, Yu fails, at even a threshold level, to teach of suggest V-shaped blades. And the vanes 54 project in a straight line fashion over the entire extent of their radial dimension.

Accordingly, in view of the present amendments and the above remarks, reconsideration and withdrawal of the rejections under 35 U.S.C. §103(a) is respectfully requested.

The Rejections Under 35 U.S.C. §101 ("Same Invention-Type Double Patenting"):

It is respectfully submitted that the following statement is true concerning "Same Invention-Type Double Patenting":

"In order for a Claim B in Application B to be validly rejected for "same invention-type double patenting" based upon a Claim A in Application A, then there must be no configuration/embodiment possible which Claim B *would* "read on" but Claim A *would not* "read on", and there must be no configuration/embodiment possible which Claim A *would* "read on" but which Claim B *would not* "read on".

Here, it is submitted that the claims of the two applications are clearly distinguished from one another. None of the claims of the present application would read on any of the embodiments disclosed in copending Serial No. 09/571,825, since all embodiments

disclosed in copending Serial No. 09/571,825 have vanes which extend radially in a straight line fashion from the hub 26.

Accordingly, it is respectfully requested that the rejections under 35 U.S.C. §101, Same Invention-Type Double Patenting be reconsidered and withdrawn.

The Rejections Under the Judicial Doctrine of "Obviousness-Type Double Patenting":

It is respectfully submitted that the following statement is true concerning "Obviousness-Type Double Patenting":

"For a valid rejection of Claim A of Application A based upon Claim B of Application B, it must be shown that the only differences between Claim B of Application B and Claim A of Application A are obvious differences. Such obvious differences between Claim B and Claim A may be supported by teachings of prior art documents."

In the present case, it is submitted that it has been shown above that each claim of the present application differs from any claims in copending Serial No. 09/571,825 by the inclusion of the recitals contained in independent base Claims 1, 11 and 21 to the effect that the radial extension of each of the V-shaped vanes is non-linear. No such or comparable recitation is present in any of the claims of copending Serial No. 09/571,825. Neither Robbie nor Yu contain any teaching of an impeller vane which is non-linear over its radial extension, and therefore neither of these cited references, nor any other art of record, can make up this deficit.

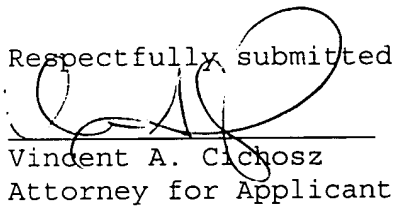
Since no other piece of prior art (reference) teaches this difference between each claim of the present application and all of the claims of copending Serial No. 09/571,825, reconsideration and withdrawal of the rejections under "Obviousness-Type Double Patenting" is respectfully requested.

CONCLUSION

It is respectfully submitted that this application is therefore now in condition for allowance, and early action toward that end is respectfully requested.

Applicant believes that the application is ready to be allowed, and thus ready to issue as a U.S. patent. If the Examiner has any questions regarding this *Amendment*, he is invited to call the undersigned attorney at the telephone number listed below.

Respectfully submitted,



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APPENDIX I

MARKED-UP COPY OF CLAIMS

(Provided pursuant to 37 C.F.R. §1.121(c)(1)(ii))

1. (Amended) An impeller for a regenerative turbine pump, said impeller comprising:

(a) a hub defining an aperture at a center thereof into which a shaft of said turbine pump is securable to allow said hub to rotate about a center axis therewith, said hub having an outer cylindrical surface;

(b) an outer ring concentric to said hub, said outer ring having an inner cylindrical surface; and

(c) a plurality of vanes extending [from] between [an] said outer cylindrical surface of said hub [to] and [an] said inner cylindrical surface of said outer ring with each said vane comprising an entrance portion that extends from said outer cylindrical surface of said hub and an exit portion that extends from a radially outward terminus of said entrance portion to said inner cylindrical surface of said outer ring, each of said vanes (i) having a V-shape of a prespecified angle centered relative to a plane normal to said center axis and (ii) having said entrance portion and said exit portion aligned in a [being at least partially] non-linear disposition with respect to one another along a dimension of each of said vanes extending between said outer cylindrical surface of said hub

and said inner cylindrical surface of said outer ring [on] along at least one of an upstream face and downstream face of said vane from said entrance portion thereof through said exit portion thereof, said entrance and said exit portions of each said vane each having a pair of outer sidewalls, each of said outer sidewalls of each said entrance portion being chamfered along a trailing corner thereof at a predetermined angle relative to said plane.

2. (Unchanged) The impeller claimed in claim 1 wherein each of said outer sidewalls of each said exit portion are chamfered along a trailing corner thereof at said predetermined angle relative to said plane.

3. (Unchanged) The impeller claimed in claim 1 wherein said predetermined angle relative to said plane is substantially equal to an angle at which a fuel stream within said turbine pump approaches said outer sidewalls of said entrance portions.

4. (Unchanged) The impeller claimed in claim 1 wherein said predetermined angle lies within a range of 15° to 45° relative to said plane.

5. (Unchanged) The impeller claimed in claim 4 wherein said predetermined angle is 30° relative to said plane.

6. (Unchanged) The impeller claimed in claim 1 wherein said prespecified angle lies within a range of 50° and 130° for said upstream face of said vane.

7. (Unchanged) The impeller claimed in claim 6 wherein said prespecified angle is 90° for said upstream face of said vane.

8. (Unchanged) The impeller claimed in claim 1 wherein said prespecified angle lies within a range of 80° and 86° for said downstream face of said vane.

9. (Unchanged) The impeller claimed in claim 8 wherein said prespecified angle is 82.3° for said downstream face of said vane.

10. (Unchanged) The impeller claimed in claim 1 wherein said aperture defined in said hub is notched to permit said impeller to be securely fitted onto said shaft of like shape.

11. (Amended) An impeller for a regenerative turbine pump, said impeller comprising:

(a) a hub defining an aperture at a center thereof into which a shaft of said turbine pump is securable to allow said hub to rotate about a center axis therewith, said hub having an outer cylindrical surface;

(b) an outer ring concentric to said hub, said outer ring having an inner cylindrical surface; and

(c) a plurality of vanes extending [from] between [an] said outer cylindrical surface of said hub [to] and [an] said inner cylindrical surface of said outer ring with each said vane comprising an entrance portion that extends linearly outward from said outer cylindrical surface of said hub and an exit portion that extends linearly from a radially outward terminus of said entrance portion to said inner cylindrical surface of said outer ring, each of said vanes having a V-shape of a prespecified angle centered relative to a plane normal to said center axis with said exit portion [thereof] of each of said vanes being inclined forward of said entrance portion of each of said vanes so as to advance toward said inner cylindrical surface of said outer ring at an exit angle with respect to a direction of rotation of said impeller, said entrance and said exit portions each having a pair of outer sidewalls, each of said outer sidewalls of each said entrance

portion being chamfered along a trailing corner thereof at a predetermined angle relative to said plane.

12. (Unchanged) The impeller claimed in claim 11 wherein each of said outer sidewalls of each said exit portion are chamfered along a trailing corner thereof at said predetermined angle relative to said plane.

13. (Unchanged) The impeller claimed in claim 11 wherein said predetermined angle relative to said plane is substantially equal to an angle at which a fuel stream within said turbine pump approaches said outer sidewalls of said entrance portions.

14. (Unchanged) The impeller claimed in claim 11 wherein said predetermined angle lies within a range of 15° to 45° relative to said plane.

15. (Unchanged) The impeller claimed in claim 14 wherein said predetermined angle is 30° relative to said plane.

16. (Unchanged) The impeller claimed in claim 11 wherein said prespecified angle lies within a range of 50° and 130° for said upstream face of said vane.

17. (Unchanged) The impeller claimed in claim 16 wherein said prespecified angle is 90° for said upstream face of said vane.

18. (Unchanged) The impeller claimed in claim 11 wherein said prespecified angle lies within a range of 80° and 86° for said downstream face of said vane.

19. (Unchanged) The impeller claimed in claim 18 wherein said prespecified angle is 82.3° for said downstream face of said vane.

20. (Unchanged) The impeller claimed in claim 11 wherein said exit angle lies within a range of 15° to 50°.

21. (Amended) An impeller for a regenerative turbine pump, said impeller comprising:

(a) a hub defining an aperture at a center thereof into which a shaft of said turbine pump is securable to allow said hub to rotate about a center axis therewith, said hub having an outer cylindrical surface;

(b) an outer ring concentric to said hub, said outer ring having an inner cylindrical surface; and

(c) a plurality of vanes extending [from] between [an] said outer cylindrical surface of said hub [to] and [an] said inner cylindrical surface of said outer ring with each said vane comprising an entrance portion that extends from said outer cylindrical surface of said hub and an exit portion that extends from a radially outward terminus of said entrance portion to said inner cylindrical surface of said outer ring, each of said vanes having a V-shape of a prespecified angle centered relative to a plane normal to said center axis and being curved with said entrance portion drawing away from said outer cylindrical surface of said hub at an entrance angle with respect to a direction of rotation of said impeller and said exit portion advancing toward said inner cylindrical surface of said outer ring at an exit angle with respect to said direction of rotation, said entrance and said exit portions each having a pair of outer sidewalls, each of said outer sidewalls of each said entrance portion being chamfered along a trailing corner thereof at a predetermined angle relative to said plane.

22. (Unchanged) The impeller claimed in claim 21 wherein each of said outer sidewalls of each said exit portion are chamfered along a trailing corner thereof at said predetermined angle relative to said plane.

23. (Unchanged) The impeller claimed in claim 21 wherein said predetermined angle relative to said plane is substantially equal to an angle at which a fuel stream within said turbine pump approaches said outer sidewalls of said entrance portions.

24. (Unchanged) The impeller claimed in claim 21 wherein said predetermined angle lies within a range of 15° to 45° relative to said plane.

25. (Unchanged) The impeller claimed in claim 24 wherein said predetermined angle is 30° relative to said plane.

26. (Unchanged) The impeller claimed in claim 21 wherein said prespecified angle lies within a range of 50° and 130° for said upstream face of said vane.

27. (Unchanged) The impeller claimed in claim 26 wherein said prespecified angle is 90° for said upstream face of said vane.

28. (Unchanged) The impeller claimed in claim 21 wherein said prespecified angle lies within a range of 80° and 86° for said downstream face of said vane.

29. (Unchanged) The impeller claimed in claim 28 wherein said prespecified angle is 82.3° for said downstream face of said vane.

30. (Unchanged) The impeller claimed in claim 21 wherein said entrance angle lies within a range of 5° to 30° and said exit angle lies within a range of 15° to 50°.

31. (Unchanged) The impeller claimed in claim 21 wherein a tangent drawn at a center portion of said vane is normal to said direction of rotation.